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Savita Bhatia
Department of Microbiology, SILB, Solan, Himachal Pradesh, India

Divya Tandon
Department of Microbiology, SILB, Solan, Himachal Pradesh, India

Corresponding Author:
Savita Bhatia
Department of Microbiology, SILB, Solan, Himachal Pradesh, India

Nutritional, therapeutic and functional aspects of goat milk based products fortified with fruit beverages

Savita Bhatia and Divya Tandon

Abstract
Beverages based on fruits and milk products are currently receiving sizeable attention as their market potential is growing. In recent years, the request for the functional beverages that promote health and wellness has increased. In fact, fermented juices are an excellent delivering means for bioactive components. Milk is a natural, multi-component, nutrient-rich beverage. Market trends indicate that milk-based beverages are ideal vehicles for newly discovered bioactive food ingredients targeting lifestyle diseases. Drinks containing combinations of dairy and fruit juices with added bioactive components are also becoming common in markets. Although a range of bioactive components is available for incorporation into dairy beverages, there are significant formulation challenges. Goat is one of the oldest domesticated animals. In ancient times also, goat milk was valued the most. Goat milk still plays an important role in human nutrition. The contribution of goats in supplying milk and milk products is high and it has significant role in rural economy and health. Goat's milk is the most highly consumed milk in many other parts of the world and it is delicious as well as extremely nutritious. It has vitamins, minerals, trace elements, electrolytes, enzymes, proteins, and fatty acids that are easily assimilated by the body. Medium Chain Triglycerides (MCT) which are more in goat milk have been recognized as unique lipid with unique health benefits. Goat's milk has a similarity to human milk that is unmatched in bovine (cow) milk and also has several medicinal values. Functional foods promise to deliver health and wellness to consumers in an environment where lifestyle diseases and an ageing population are threatening the wellness of society. Fermented milk products are functional foods that contain biologically active substances with health-beneficial properties.

Keywords: beverage, goat milk, functional food, market trend

1. Introduction
Beverages based on fruits and milk products are currently receiving significant attention as their market potential is growing. Soft drink industry had made sizeable progress during recent years in terms of production. Many type of syrups, sherbets and soft drinks containing artificial fruits flavours are well known all around the world. The basic consideration of the beverage is the caloric and therapeutic values, which make them popular and acceptable (Sakhale *et al*., 2012) [53].

U.S. Foundation for Innovation in Medicine in 1989 introduced the word ‘nutraceuticals’ which refer to “any substance that is a food or a part of a food and provides medical or health benefits, including the prevention and treatment of disease”. On the other hand, Japan introduced the concept of ‘functional food’ in the mid-1980s for foods containing ingredients with functions for health. Today, the range of functional foods includes products such as baby foods, baked goods and cereals, dairy foods, confectionery, ready meals, snacks, meat products, spreads, and beverages.

Particularly, beverages are by far the most active functional foods category because of convenience and possibility to meet consumer demands for container contents, size, shape, and appearance, facility of distribution and better storage for refrigerated and shelf-stable products great opportunity to include desirable nutrients and bioactive compounds. The different types of commercially obtainable products could be grouped as follows dairy-based beverages including probiotics and minerals/ω-3 enriched drinks, vegetable and fruit beverages, and sports and energy drinks. Fruit beverages are well enjoyed by every age groups of the society (Balaswamy *et al.*, 2011) [10]. Fruit beverages are immensely nutritive, refreshing, thirst quenching, appetizing and easily digestible. Blended drinks are good alternative for development of new products to provide benefit of taste, nutrition and medicinal properties (Sindumati *et al.*, 2017).

Medicinal plant extracts most oftenly serves as functional constituents, primarily due to their therapeutic effects in terms of employing the enrichment addition of other functional ingredients to a food product (Zeng *et al*., 2001). Functionality is defined as "any property of a food, or a food ingredient, excluding its nutritional ones, that affect its utilization (Sabahelkhier *et al*., 2012) [51]. Consumers' requirements in the food field have changed considerably. Consumers show an increased request for foods and drinks that can stimulate wellbeing, which stimulate functional food production (Ayed *et al.*, 2020) [9]. Human beings try to find new substitutes of foods and researchers conduct studies for more and healthier foods. The milk of different ruminant species, either directly or as dairy products, comprises a food of outstanding significance for humans throughout their lives (Ceballos *et al.*, 2009) [14]. Milk base fortification is one of the most important steps that magnify the functional and nutritional properties (Bruzantine *et al.*, 2016). The increasing realisation of the health hazard related with the harmful side effects of many synthetic medicines and also the hazard linked with indiscriminative use of modern medicine such as antibiotics, steroids and other synthetic drugs have given a new impetus to the study of medicinal plant with a vision to develop novel herbal drugs and increasing popularity in plant based drugs, pharmaceuticals, neutraceuticals, functional foods and even cosmaceuticals (Ebel *et al.*, 1994). From different types of milk, various characterstics of fermented milk beverage products are obtained. Milk is a major contributor to improving nutrition and food security particularly in developing countries. Improvements in livestock, dairy technology and milk quality may offer the most promise in reducing poverty and malnutrition in the world. Milk and its derivatives are suggested as being useful foods throughout all life periods, in particular during childhood and adolescence, when their contents of calcium, protein, phosphorus, and other micronutrients might promote skeletal, muscular, and neurologic development (Visioli *et al*., 2014). The reasons for their popularity lie in the unique properties and components of milk, as well as a possibility of producing a wide variety of foods from this material (Sukhikh *et al*., 2019) [59].

Milk composition of mammalian species varies broadly with reference to genetic, physiological, nutritional factors and environmental conditions. The milk proteins used to give food desirable organoleptic or textural properties is strongly influenced by their functional properties (Sabaliheilikher *et al.*, 2012).

Goat milk has numerous benefits on human health, even more than cow milk. Goat is one of the oldest domesticated animal, its production contributes an important part of the national economy in many countries, especially in the Mediterranean region and the Middle East. Goats are living in climates ranging from high altitude mountains to deserts (Pal *et al.*, 2017) [44]. Goat milk has been an important part of human nutrition for millennia (Clark *et al.*, 2017) [16] but during past years, goat's milk has received increasing attention due to its specific and highly valuable nutritive composition, biological and therapeutic values. Improved digestibility, higher mineral composition quality, buffering capacity, higher therapeutic efficiency and many other characteristics are significantly differing goat's milk from other milk types (Komes *et al.*, 2017) [33].

Due to its high medicinal value for human health, the value of goat milk has increased globally (Pal *et al.*, 2014) [45]. Today, an increase in demand by consumers is being observed towards consuming goat milk, mainly owed to their rich nutraceutical value (Bhat *et al*., 2016) [11]. Goat milk is rich in different physiologically functional components, including proteins, vitamins (such as vitamins E and C), flavonoids, and carotenoids with antioxidant properties. These nutritional, health and therapeutic benefits enlighten the potentials and values of goat milk and its specialty products. Goat milk and its processed products are greatly useful as functional foods, maintaining nourishment and health for young and elderly, especially those who have cow milk allergy (Yangilar *et al.*, 2013) [65].

In general, Fresh goat milk have less microbial load. Because of higher digestibility (small fat globules) and less allergic reactions (low α casein content) goat milk and its products have played an important role in human nutrition. The benefits are also imputed to biofunctional components such as medium-chain triglycerides, polyunsaturated fatty acids and some serum proteins. Goat milk is a good source of Potassium, an essential mineral for maintaining normal blood pressure and heart function. A wide variety of products, including fluid beverage products can be manufactured by using chemical characteristics of goat's milk (Ribeiro *et al*., 2010) [49]. The symptoms like gastrointestinal problem, vomiting, colic, diarrhoea, constipation and respiratory disturbance can be eliminated when goat milk is fed to the infants. Infants with gastro intestinal or respiratory symptoms can well tolerate the pasteurized goat milk. When compared to cow's milk, fermented milk forms a soft curd and hence helps in easy digestion and absorption.

Regular intake of goat milk can significantly improves the body weight gain, mineralization of skeleton, increased blood serum vitamin, mineral and haemoglobin levels (Morgan *et al*., 2012) [42]. Raw goat's milk is still very often unacceptable among a large number of consumers due to its distinctive and characteristics taste and flavour attributed to the presence of free short chain fatty acids. So, addition of medicinal plant extracts to goat's milk may contribute to the improvement of bioactive and sensory of this food substrate. The composition of whole cow milk may not be optimal, with more protein and fewer micronutrients (e.g., iron, vitamin D) than may be required during rapid growth and development for young children and led to the formulation of fortified milk drinks intended to supplement the diets of children above 12 months (Park *et al.*, 2007) [47].

Functional food products are manufactured through the addition of exogenous natural compounds or probiotics or other microorganisms that produce biogenic compounds. Currently, fermented milk is the most common matrix for commercial functional beverages (Al-Hindi *et al*., 2020) [4]. Current developments in functional foods are fuelled by the rapid increase in lifestyle diseases and the preference by innovative companies to seize the resulting opportunities to market bioactive ingredients addressing these diseases (Sharma R *et al*., 2005) [54].

Functional properties of dairy products are normally improved by correcting their composition of fatty acids, amino acids, and minerals, as well as fortifying them with micronutrients (Sukhikh *et al*., 2019) [59]. Corbo *et al*., 2014 [18] reported that functional foods represent one of the most interesting areas of research and innovation in the food field. The different approaches could be grouped as follows: (1) exploitation of microorganism functionality, (2) optimization of the production and formulation of novel functional beverages, (3) use of prebiotics and synbiotics, (4) use and processing of natural ingredients, (5) use of by-products of

fruit and food industries as functional ingredients. Bioactive compounds derived from natural foods like fruits and vegetables can exert functional and health-promoting effects through bioactivity beyond the basic nutrient composition. Further, there has been a growing demand for beverages enriched with bioactive compounds having health-promoting characteristics besides quenching one's thirst and providing nutrition (Sharma *et al*., 2020) [55]. Fortified milk drinks have been demonstrated to reduce the occurence of insufficient micronutrient intake in circumstances of unbalanced dietary intake while potentially limiting the risks of excessive protein intake. Fortified milk products have also emerged for adolescent or such as the elderly, contributing a means of caloric regulation. In goat dairy beverages, sensory matching is more difficult, which presents a less favourable protein profile to reach a firm structure (Park *et al.*, 2007) [47]. As consumers become more health conscious, interest in concentrated and fortified beverages is increasing, and its market share is growing. Consumers are demanding a variety of beverage options, because of lifestyle and health concerns (Sharma *et al*., 2020) [55].

The fruit juice-based beverage is a fast growing sector within the beverage market and ready- to- serve beverages are more popular among these beverages (Sharma *et al*., 2020) [55]. Fruit beverages are well enjoyed by all age groups of the society (Balaswamy *et al.*, 2011) [10]. Fruit beverages are highly nutritive, refreshing, thirst quenching, appetizing and easily digestible. Blended drinks are good alternative for development of new products to provide benefit of taste, nutrition as well as medicinal properties (Sindhumathi *et al*., 2017). Fortified probiotic drinks are a new step in the development of the food industry. Fermented milk products are functional foods that contain biologically active substances with health-beneficial properties. It is generally recognised that probiotics serve as an important tool to prevent and treat dysbiosis resulting from irrational antibiotic therapy, intestinal diseases, improper nutrition, or stress. Among conventional probiotics are lactobacilli and bifidobacteria. Their beneficial effects are manifested in normalising intestinal microflora, activating the entire gastrointestinal tract, and improving calcium absorption. They also perform anti-allergenic and immunostimulating functions (Sukhikh *et al*., 2019) [59].

A probiotic product have numerous health benefits, including antimicrobial, antimutagenic, anticarcinogenic, and antihypertensive effects as well as reduces serum cholesterol, alleviates lactose intolerance, reduces allergic symptoms, reduces diarrhoea, and stimulates the immune system (Al-Hindi *et al*., 2020) [4].

Functional beverages can be useful to support the immune system, improve gut or cardiovascular health, help in weight management, or act as an adjuvant to counteract the aging processes. Fruit juices are becoming popular, since they provide health benefits (Sharma *et al*., 2020) [55]. It appears that people will not compromise on taste, because they want to enjoy their food regardless of health status. Dairy beverages easily fulfil the requirements for the three main drivers of functional foods, i.e. health, taste and convenience (Sharma R. *et al*., 2005) [54].

2. Review of Literature

2.1 Beverage

Beverage imply those flavored drink, suitable for a hot humid scorching day, when nothing seems at peace with oneself making them apropriate in human consumption (Pushpangandan *et al*., 2011).

Beverage is a liquid formulation especially prepared for human consumption. Beverages are refreshing drinks. They include the carbonated non-alcoholic, and the non-carbonated or "still" beverages, such as fruit drinks and fruit juices. Beverages provide water, an important nutrient which is essential for good health and the prevention of dehydration. Some contain carbohydrates to provide a sweet taste and as a source of calories to meet the body's energy requirements, and either natural or added vitamins, which is needed daily for good health. Corbo *et al.*, 2014 [18] suggested that recently, there has been growing recognition of the vital role of foods and beverages in disease prevention and treatment. Thus, the production and consumption of functional foods has gained much importance as they provide a health benefit beyond the fundamental nutritional functions. Currently, beverages are by far the most active functional food category because of convenience and possibility to meet consumer demands for container contents, size, shape, and appearance, as well as ease of distribution and storage for refrigerated and shelf-stable products. Furthermore, they are an excellent delivering means for nutrients and bioactive compounds including vitamins, minerals, antioxidants, ω-3 fatty acids, plant extracts, and fiber, prebiotics, and probiotics.

Beverages based on fruits and milk products are currently receiving sizeable attention as their market potential is growing. In terms of production, soft drink industry had made significant progress during recent years. The basic thoughts, which make them popular and acceptable is the caloric and therapeutic values (Sakhale *et al*., 2012) [53]. Milk and dairy products have always been acknowledged as an important part of human diet both in developing as well as developed nations of the world (Pal *et al*., 2017) [44].

Afreen *et al.*, 2016 prepare RTS beverages by using Sour-Orange juice and carrot juice. It is accomplished that the RTS beverage with 50:50 carrot juice and sour orange juice is most effective beverages with high nutritional qualities. Sensory scores of RTS beverage with 50:50 carrot juice and sour orange juice (T3) also higher than other formulation. Carrot juice and sour orange juice blend RTS beverages is free from any microbial contamination and best for the commercial preparation of based on the nutritional and sensory evaluations.

Kumar *et al*., 2013 [38] develop blended therapeutic RTS using aloe vera, aonla fruits and ginger juices. Aloe vera gel contained high moisture content while aonla fruits juice dominated in its vitamin C content; TSS, acidity and pH are very similar characteristics. Sensory quality revealed that aloe vera gel could be successfully incorporated with aonla fruits and ginger juices in development of blended therapeutic RTS with improved sensorial quality profile up to the level of 70% while with 15% aonla fruits juice and 15% of ginger juice extracts. The storage studies revealed that blended therapeutic RTS made from aloe vera gel aonla fruits and ginger juices extracts could be successfully stored for the period of 4 months without significant change in chemical and sensory qualities.

Chatterjee *et al.*, 2015 [15] utilize whey to develop an orange-based fruit beverage with optimum sensory and nutritional properties as well as good storage stability. A nutritious beverage with better storage life is developed with the inclusion of whey, orange juice and sugar in appropriate proportion. When stored in the fridge and after adding authorized limit of preservatives, the beverage can be stored

for about three months. Considering functional properties arising from bioactive constituents present in fruit and whey, it is proposed that orange based whey beverages with excellent nutritional, sensory and storage properties could be an interesting product in the constantly growing market for functional foods.

Dhamsania *et al.,* 2013 concluded that the RTS beverage could be prepared from the ripe banana juice and milk whey using *M. arvensis* extract as natural flavoring agent. The proportion of banana juice and *M. arvensis* extract may be taken as 15 ml and 3 ml per 100 ml of the RTS beverage preparation for getting the optimum physicochemical characteristics and organoleptic quality, respectively.

Ahmed *et al.,* 1992 [3] manufactured three types of fruit preparations (Guava, Orange and Fig) for fortifying skim goat milk in order to prepare low fat beverages. The obtained beverages were analysed for some physical, microbiological and organoleptic properties during 10 days storage at
5 + 10. The acceptance of the resultant beverages depended upon the type of fruit syrup and its concentration Guava (10%) beverage was the most acceptable one, followed by 15% Orange beverage and then the beverage containing 10%. Control and flavoured beverages were free from coliform spores, moulds and yeast during 10 days of storage.

Hassan *et al.,* 2014 chemical characteristics of pasteurized goats milk and goat milk kefir prepared using different amount of Indonesian Kefir grains and incubation times had been studied. Kefir samples were prepared using amount of Kefir grains 3, 5 and 7% (V/V) with incubation time of 8, 21 and 24 hours, respectively, and controls were made without kefir grains and before incubation. The resulted showed that pasteurized goat milk samples contain: Fat 3.43%, protein 4.72%, lactose 4.30%, titratable acidity number as lactic acid content 0.19% and pH value of 6.66 while the best chemical characteristics (pH 4.37, ethanol content 0.917, titratable acidity number 0.76%; and lactose content: 4.23%) was obtained from goat milk kefir prepared with 7% (W/V) kefir grains and incubation time of 24 hours.

Sharma *et al.,* 2020 [55] developed apple-whey beverage (75% sweetos) contained 1.59 per cent fruittooligosaccharide content and 40.54 Kcal/100 g energy value, besides other nutritional compounds depicting its functionality as low calorie prebiotic beverage.

Ismail *et al.,* 2011 [30] developed Whey Based Mango beverage also check the storability of beverage at 4±1ºC for 30 days. The storage study showed that there is an increasing trend in the TSS, acidity, and reducing sugar and a decreasing trend in the pH and ascorbic acid but total sugar has non-significant effect during storage. Total viable count, Yeast and mold count, Coliform count, and *Salmonella* count was analyzed using standard methods. The Total Viable Counts (TVC) was high ranging from 2.60-2.76×104 cfu/mL. Yeast and mould count varied between 3.60-2.61×103 cfu/mL whereas Coliforms include both the presence of fecals 4.5-3.6×104 cfu/mL and non fecals 2.61-3.00×102 cfu/mL and *Salmonella* were not observed in most of the tested samples.

Freire *et al.,* 2017 [25] evaluate the the effect of grape probiotic fermented beverages made of goat milk. Beverages formulated, with or without grape pomace extract, exhibited high dietary fiber, oleic acid, phenolic compounds content and antioxidant activity. Both beverages also kept *L. rhamnosus* and *S. thermophilus* viable during their passage through the intestinal tract and had a
positive effect on gut microbiota metabolism, increasing the antioxidant capacity and the production of short-chain fatty acids, and decreasing the ammonium concentration.

Sakhale *et al*., 2012 [53] Whey and juice of mango (Cv. *Kesar*) were utilized at various combinations (70:30, 75:25 and 80:20) forpreparation of nutritious ready-to-serve (RTS) beverages and evaluated for various physico-chemicals and sensory attributes during storage. The study revealed that the RTS beverage prepared with 70% whey and 30% mango juice scored maximum for almost all sensorial quality attributes such as appearance, color, flavor, taste and overall acceptability and also found highest in ascorbic acid content (9.80mg/100g). A reducing trend was observed in total sugars and ascorbic acid and increasing trend was observed in reducing sugars and acidity content during the storage of beverage at refrigeration temperature over a period of 30 days. The beverage remained unchanged with respect to TSS content along the storage period.

Dande *et al*., 2019 prepared whey based ready to serve (RTS) beverage by using Strawberryfruit extract juice with different levels of strawberry juice in which sugar was added and composition of whey is decreased by increasing the content of strawberry fruit extract juice on the basis of whey in the treatment T1, T2 andT3 respectively. Control treatment (T0) was the whey. Sensory evaluation was carried out by panelists on the basis of 9 point hedonic scale. The results are compared between the treatments T1, T2 andT3 for overall acceptability.

Rizzolo *et al*., 2018 prepare a beverage by blending Ricotta-cheese whey (RCW) by-product of Ricotta cheese production, with fruit juices. Pear-RCW had higher malic acid and sorbitol, blueberry-RCW higher citric acid, total phenolics and anthocyanin pigments, apple-RCW higher sucrose and fructose, and strawberry-RCW higher glucose. Blueberry-RCW had the highest SI and the lowest TSI, while apple-RCW had the lowest SI and the highest TSI. Higher quality beverages may be obtained by using apple juice (‘Yellow’ type) and the apple: blueberry (50:50) blend (‘Red’ type).

Table 1: Functional beverages (Corbo *et al*., 2014) [18]

Products	Active compounds
Fortified fruit juice beverage	Prebiotics: fructooligosaccharides
Fortified-strawberry beverage	Polyphenols (rose petals, *Rosa damascena* Mill.)
Fortified blackcurrant juice	Polyphenols (crowberry, *Empetrum nigrum*)
Fortified vegetable-beverage	Vitamins, minerals, polyphenols omega-3 fatty acids, proteins, digestible carbohydrates (whey, mango fruit)
Fortified fruit juice	Antioxidants (brewers’ spent grain)
Grape-based fermented beverage with potential anti-hypertensive effect	Polyphenols (grape must); γ -amino butyric acid (*L. plantarum* DSM19463)
Beverage with anti-inflammatory Properties	Phenolic compounds, parthenolide (feverfew, *Tanacetum parthenium*)
Fruit and milk-based beverages	Plant sterols (tall oil, and soybean, rapeseed, sunflower and corn oils)
Antioxidant dairy-based beverage	Antioxidants (extract of oregano, *Origanum vulgare*; essential oil of oregano,

	Origanum minutiflorum)
Antioxidant beverage	Polyphenols (red grape, *Vitis vinifera* L.; elderberry, *Sambucus nigra* L.)
Apple-based beverage with anti-diabetic properties	Secoiridoid glycosides (*Fraxinus excelsior* seed extract)
Fermented carrot juice beverage	Prebiotics: inulin and fructooligosaccharides; Probiotics: *L.rhamnosus* DSM20711, *L. bulgaricus* ATCC 11842
Fortified fruit juice beverage	Prebiotics: fructooligosaccharides

2.2 Goat milk

A goat is universally known as "Poor man's cow". Currently, India possesses 126 million goats which contribute 14.5% of the world. The goat is one of the main contributors of dairy and meat products for rural people, more than any other mammalian farm animal, especially in developing country. One of the eminent aspects of demand of goat milk is its home consumption (Kumar S *et al.*, 2017) [36]. Goats are important part of livestock industry having adaptability to harsh climates which make them suitable for landless and marginal farmers. The contribution of goats in supplying milk and milk products is high and it has remarkable role in rural economy and health (Bhattarai *et al*., 2012) [12].

Goat (*Capra hircus*) milk production has significant importance to the economy and survival of large populations of many countries in the world, in developing countries (i.e. Asia, Africa, the Middle East and Mediterranean countries and South America) as well as in developed countries (i.e. Europe, North America and Oceania) (Yangilar *et al*., 2013) [65]. Goat milk is very nutritious and is an acceptable food in some parts of the tropical area. Over 210 breeds of goats have been estimated among 450 million goats in the world. India has the second highest goat population in the world (Arora *et al.*, 2013) [7] about 135.17 million of goat population was estimated in India in 2012 (Pal *et al.*, 2017) [44]. There are twenty well defined breeds of goats in India, while 70% population are non-descript and meat type. Some of the breeds includes Jamunapuri, Barbari, Beetal, Surti, Jakhrana produce fairly good amount of milk. Goats in India has produce around

2.76 million tonnes of milk which is 22.28% of World's production and 3% of total milk produced in the country. About 2% of the world's total annual milk supply is produced by the goat. Because of the large amounts of unreported home milk consumption, especially in developing countries, milk production of goats is likely to be much greater than reported in official statistics (Haenlein *et al.*, 2004) [28].

During dairy product manufacture, goat milk is subjected to different pre-treatments to ensure its microbiological safety. Fresh goat milk is a white, opaque liquid with a moderately sweet taste and practically no odor equipment (Young *et al.*, 2010) [66].

In recent times goat farming is gaining an importance in the world. Factors that are effective in this are - the production of goats milk, and its processing constitutes an economic activity of increasing importance due to high nutritional interest of goats' milk, as it provides high quality protein, fat, carbohydrates, vitamins, and several minerals, such as iron, calcium, and phosphorus (Yangilar *et al.*, 2013) [65]. Milk and dairy products have always been conceded as an important part of human diet both in developing as well as developed nations of the world (Pal *et al.*, 2017). Processing the milk is an alternative to modify fresh milk into milk products with better sensory properties, so that increase milk consumption (Suriaish *et al.*, 2014).

Goat milk has a stronger flavor than sheep milk and alkaline in nature due to higher protein content and a different arrangement of phosphates. Goat milk has smaller size fat globules as compared to cow milk which provides a smoother texture (Pal *et al.*, 2017) [45]. Goat milk is a essential source of nutrients, which are required for infant, and children besides, it serves as a medicinal food for persons suffering with milk allergies, and other diseases such as asthma, insomnia, migraine, eczema, neurotic indigestion, acidity, stomach ulcer, colitis, constipation, gall bladder stones and liver disorders (Yangilar *et al.*, 2013; Pal *et al.*, 2014) [65, 44]. Goat milk has played a key role in health and nutrition of young and elderly. Goat milk has also been known for its beneficial and therapeutic effects on the people who have allergy to cow milk. These nutritional, health and therapeutic benefits enlighten the potentials and values of goat milk and its specialty products (Yangilar *et al*., 2013) [65]. Goat milk is sufficient for human infant in vitamin A and niacin and supplies generous excesses of thiamin, riboflavin and pantotheanate (Jenness *et al.*, 1980; Haenlein *et al.*, 2004) [28, 31], although goat milk is deficient in vitamins C, D, B12, pyridoxine and folic acid. Thus, when goat milk is used for infant feeding, must be corrected by appropriate fortification (Bhattarai *et al.*, 2012) [12].

These nutritional properties and lower allergenicity of goat milk in comparison to cow milk, higher proportion of short chain fatty acids, and smaller size of fat globules has led to an increased interest in goat milk as a functional food (Yangilar *et al*., 2013) [65]. Wide variety of dairy products such as butter, ice cream, cheese, butter milk, condensed milk, yoghurt, flavored milk, sweets and candies can be prepared with goat milk (Pal *et al.*, 2017) [44]. Haenlein *et al.*, 2004 [28] reported the use of goat milk as an excellent food source is undeniable. It has beneficial effects for health maintenance, physiological functions, in the nutrition of children and elderly people.

According to some authors, goat milk can be consumed without negative effects by people suffering cow milk allergy. Depending on genetic factors, environment conditions, and goat farming practices, goat milk shows great variability in biochemical composition, technological properties and bacteriological quality (Anifantakis *et al.*, 1980) [6].

One of the important aspects of demand of goat milk is its home consumption.This demand is increasing day by day because of the growing populations of people. The second important aspect of demand for goat milk is the great interest in goat milk products especially, cheeses and yoghurt in several developed and developing countries. This demand is increasing because of the rising levels of per capita incomes. Moreover, another important aspect of demand for goat milk derives from the affliction of persons with cow milk allergies and other gastro-intestinal ailments. This demand is also increasing because of a greater awareness of problems with traditional medical treatments to such afflictions among the people (Kumar S *et al.*, 2017) [36]. Goat milk also act as functional food. According to the Consensus Document issued by the European Concerted Action on Science of Functional Foods, a food may be referred to as "functional", if it has been indisputably proven that it positively influences one or more biological functions in the human body, improving the state of health and wellness, and reducing the chance to develop a disease. In addition to interest of

industries and consumers for functional foods has been increasing exponentially.

Presently, there is an awaken awareness on preventive rather than curative health care. And it has been discovered that consumption of functional foods will serve as key instrument for preventive health care, globally, the consumption of functional foods is being encouraged. The functional value of goats' milk may be further utilized through fermentation by selected microorganisms possessing specific characteristics. A mixed starter comprising *Lactobacillus acidophilus*, *Bifidobacterium lactis* and *Streptococcus thermophilus* has been successfully used for fermentation of goats' milk and a high viability of probiotic strains in a fermented goats' milk stored at C for 10 days has been reported. Fermentation is considered as a low-cost process which preserves the food and improves its nutritional and sensory characteristics. Many cultures were used as starter cultures for fermented juices and have been recognized as probiotics (Perricone *et al*., 2015) [48]. Currently, functional foods are typically marketed to large groups of the total population. Scientific evidence confirming the relationship between food and health has promoted the rapid development of a new food market in past few years the functional food market. Low allergenicity in comparison to cow milk, especially in non-sensitized children has led to an increased interest in goat milk as a functional food, and it now forms a part of the current trend to healthy eating in developed countries. Nutritional, health and therapeutic welfare enlighten the potentials and values of goat milk and its specialty products (Yangilar *et al*., 2013) [65].

2.3 Properties

2.3.1 Goat Milk is naturally homogenized

When both of fresh cow milk as well as fresh goat milk are refrigerated overnight in a glass, it is found that the goat milk looks exactly the same however the cow milk separates into two phases with cream on top and skim milk at the bottom. This is a natural phenomenon established by a compound called agglutinin. To destroy the fat globule cell wall in order to allow cream and skim milk to stay homogenous mechanically homogenized and this mechanical homogenization releases a free radicals which may cause many problems inside the body even causing mutation. Goat milk contain smaller fat globules and lacks agglutinin allowing milk to stay naturally homogenous thus eliminating the concerns correlated with mechanical homogenization processes (Kumar A *et al*., 2016) [35].

2.3.2 Goat Milk Resembles Human Milk

Human milk is more similar to goat milk than the cow milk which may be the reason for goat milk healing properties. However no food is better than mothers' milk at least for the first six months of life. The oligosaccharide profile of goat milk is mostly similar to that of human milk and the goat milk oligosaccharides could be included in infant formulas to improve the nutrition of infants. Non protein nitrogen (NPN) contents of goat and human milks are higher than present in cow milk. Goat milk also bear a resemblance to human milk in the protein structure. The major casein protein Beta casein found in both goat and human milk is different from the casein found in cow milk (El-Agamy *et al*., 2007) [24]. Goat milk proteins are also key sources of bioactive acetyl cholinesterase (ACE) inhibitory and antihypertensive peptides which can provide a non- immune disease defence and control of microbial infections (Kumar A *et al*., 2016) [35].

2.3.3 Goat Milk is Less Allergenic

Cow milk allergy is prime allergy found in children, affecting roughly 0.5 to 1.5 million children every year. More than 20 allergen proteins are found in cow milk (El-Agamy *et al*., 2004) [24] which are not recognized by the immune system leading to a variety of symptoms like hives, wheezing, vomiting, abdominal cramping, diarrhoea, skin rash (commonly near and around the mouth), runny nose, watery eyes, colic in infants and even anaphylactic shock. Alpha s1 casein is the main allergens in cow milk however goat milk, like human milk, contains low levels (89% less than cow's milk) of alpha s1 casein and high levels of alpha s2 casein, which is non-allergic. After shifting to goat milk, infants suffering from allergies with eosinophilia associated with the gastrointestinal tract showed improvement. In addition, it is also reported that the chronic enteropathy due to feeding of cow milk can be cured by shifting to goat milk (Kumar A *et al*., 2016) [35].

2.3.4 Goat Milk is rapidly digested and absorbed

Goat milk has superior digestibility and absorption than cow milk. Goat milk has excessive amount of short chain fatty acids and medium chain fatty acids than cow milk. These short chain fatty acids and medium chain fatty acids has a larger surface-to-volume ratio and are better digested and absorbed than the long chain fatty acids found in cow milk. Recently, it was found that "levels of the metabolically valuable short and medium chain fatty acids like caproic, caprylic, capric and lauric acids are significantly higher in goat milk than in cow milk (Park Y.W *et al*., 2007) [47]. These higher levels of easy-to-digest short chain fatty acids and medium chain fatty acids are broken down rapidly and more completely than the long chain fatty acids plentiful in cow milk. Medium-chain fatty acids, such as capric and caprylic acids have high antimicrobial properties. The medicinal property of these medium chain fatty acids lowers the deposition of cholesterol in the arteries, helps in dissolving cholesterol and gall stones and notably contributing to the normal growth of infants. These medium chain fatty acids also play an important role in improving the conditions like steatorrhea, chyluria, hyperlipoproteinemia, cystic fibrosis, gall stones, and childhood epilepsy. Goat milk also contains higher amount of energy rich substrate adenosine triphosphate (ATP) than cow milk. Goat milk also contains free amino acids such as taurine, glycine and glutamic acid. Taurine plays a vital role in bile salt formation, osmoregulation, antioxidation, and calcium transport and also in central nervous system. About 20-40 times of taurine is higher in goat milk than the cow milk (Kumar A *et al*., 2016) [35].

2.3.5 Goat milk as antioxidant

Human health is positively affected by antioxidants by protecting the body against damage caused by reactive oxygen species (ROS), which attack membrane lipids, protein, and DNA. Organisms are also protected by antioxidants against free radicals (Free radicals can adversely change lipids, proteins and DNA causes lipid peroxidation, loss of enzyme activity and mutagenesis and carcinogenesis (Karthi *et al*., 2018) [32] but a sufficient concentration of antioxidants is necessary to balance the disruption caused by these radicals. Reactive oxygen species and other free radicals are significantly involved in many degenerative diseases recommended fresh milk intake, particularly breastfeeding, as an important food source of antioxidants to prevent or reduce oxidative damage in various body tissues. Furthermore,

studies have shown that goat and other animal's milk exhibit antioxidant properties but these antioxidant properties of milk may be affected by different factors such as: milk pasteurization treatment, level stage of milk lactation and geographic location of farm (Saif *et al.,* 2014) [52].

2.3.6 Lactose Intolerance

Condition, due to the deficiency or lack of enzyme lactase is called lactose intolerance. Easier digestion of the goat milk allows the lactose to pass through the intestines quickly, not giving it time to ferment or cause an osmotic imbalance means there is no "leftover" lactose. Goat milk contains 10% less lactose than cow milk. Most lactose intolerant people are able to develop well on goat's milk and goat milk products (Kumar A *et al*., 2016) [35].

2.3.7 Composition and Nutritional value of goat milk

Depending on genetic factors, environmental conditions, and goat farming practices, goat milk shows great variability in biochemical composition (Yangilar *et al*., 2013) [65]. Compared to cow or human milk, goat milk reportedly possesses remarkable biologically active properties, such as high digestibility, distinct alkalinity, high buffering capacity as well as certain therapeutic values in medicine and human nutrition (Park and Haenlein, *et al.,* 2007) [47].

The nutritional advantages of goat milk over cow milk do not come from its protein or mineral differences, but from the lipids, more specifically the fatty acids within the lipids. With regard to content of milk sugar as well as protein, goat milk can be nutritionally comparable to the cow milk. Due to its low fat content and its capability to neutralize the acids and toxins present in the body, goat milk is the most complete food known which is highly compatible and nourishing natural food (Bhat *et al*., 2016) [11].

2.3.8 Proteins

In general, two main groups of milk protein are differentiated namely casein micelles and whey protein. The main protein is casein which represents approx. 80% of the total protein. Goat whey proteins were separated to 5 fractions as β-lg (presented 60% to total WP), α-la, serum albumin, immunoglobin and protease peptones. Goats milk content 2.75% total protein, 0.433 (g/100 g) whey proteins and 0.119 (g/100g) have been reported by (Abbas *et al*., 2014) [1]. Mehmood *et al*., 2010 have mentioned 2.38 – 3.48% protein in goat milk. Park *et al*., 2007 [47] have recorded 3.4% protein in goat milk. This data was also confirmed by (Pal *et al*., 2017) [44]. Proteins are organic compounds composed of amino acids arranged in a linear chain and folded in to globular (Tafes *et al.,* 2020). Goat milk is a source of complete protein which contains all vital amino acids. Goat milk contains a similar amino acid profile to cow and human milk except for a lower concentration of cysteine. Goat milk is also a valuable source of taurine for the human neonate and the adult. (Ulusoy *et al*., 2015) [63] Goat milk proteins are also important sources of bioactive acetyl cholinesterase (ACE) inhibitory and antihypertensive peptides. They can supply a non immune disease defence and control of microbial infections (Kumar *et al*., 2016) [35].

2.3.9 Lipid

Essentially fat is composed of glycerides and steroids (99%). Goat milk has higher content of fat than cows and human milk. Lipids in goat milk contain higher physical characteristics, than in cow milk. Composition of fat in milk ranges widely due to genetic, lactational, and nutritional factor difference between different species. Goat milk has a higher content of small fat globules. (Mehmood *et al*., 2010) illustrate that fat in goat milk ranges from 3.16 - 4.13%. Pal *et al*., 2017 [44] reported *3*.8% fat in goat milk. Goats milk has higher digestibility, due to reduced dimensions of casein micelles and fat globules and higher proportion of short to medium fatty acids, and havelower allergenic properties than cows' milk (Yangilar *et al*., 2013) [65]. Lipids are the most important components of milk in terms of cost, nutrition, physical and sensory characteristics (Park *et al*., 2007). Our body can digest goat milk in just 20 minutes while it takes 2-3 hours to digest cow milk because the total surface area of the globules is very to effectively get in contact with the lipids (Cebellos *et al.,* 2009) [22]. Goat milk is also rich in medium chain triglycerides (MCTs), which is one of the main reasons that it facilitates improved nutrient absorption and energy production in the body (Zenebe *et al*., 2014) [67]. Owing to the high amounts of short and medium chain fatty acids (MCT), goat milk fat may have at least three significant contributions to human nutrition as it may be more rapidly digested than cow milk fat, because lipase attacks ester linkages of short or MCT more easily than those of longer chains, these fatty acids exhibit beneficial effects on cholesterol metabolism such as hypocholesterolemic action on tissues and blood via inhibition of cholesterol deposition and dissolution of cholesterol in gallstones, and they have been therapeutically used for treatment of malabsorption patients suffering from steatorrhea, chyluria, hyperlipoproteinemia, and in case of intestinal resection, coronary bypass, childhood epilepsy, premature infant feeding, cystic fibrosis and gallstones. The short or MCT have the unique metabolic ability to provide direct energy instead of being deposited in adipose tissues, and lower serum cholesterol and inhibit cholesterol deposition (Alferez *et al*., 2001) [5].

2.3.10 Lactose

In goat milk lactose is the major carbohydrate and main constituent of the dry matter of milk (Abbas *et al*., 2014, Zenebe *et al*., 2014) [1, 67]. Lactose is a valuable nutrient, because it favours the intestinal absorption of calcium, magnesium and phosphorous and the utilization of vitamin D (Cebellos *et al*., 2009) [22]. The other carbohydrates found in goat milk are oligosaccharides, glycopeptides, glycoproteins and nucleotides in small amounts. Milk oligosaccharides are thought to be beneficial to human nutrition, due to their prebiotic and anti-infective properties (Kunz *et al*., 2000) [38]. The lactose concentration is usually found to be lower than that found in cow's milk. Goat milk contains about 4.23% lactose (Helmut *et al.,* 2012) [29]. Mehmood *et al*., 2010 have reported 3.70 – 4.88% lactose content in goat milk. (Park *et al.,* 2007) [47] showed 4.1% of lactose in goat milk. This data was also confirmed by (Pal *et al*., 2017) [44].

2.3.11 Vitamin

Goat milk has a higher vitamin K (Bhattarai *et al*., 2012) [12] and vitamin A content than cow milk because goats convert all carotene from foods into vitamin A in the milk. For the same reason, goat milk is always whiter than than the milk of cow (Conesa *et al*., 2008). Goat milk has a higher vitamin A content than cow milk because goats convert all carotene from foods into vitamin A in the milk (Conesa *et al*., 2008) and also have low concentrations of vitamin B6 and Vitamin D, vitamin D plays an important role in the immune system and may help prevent infections, autoimmune diseases, cancer

and diabetes (Zenebe *et al*., 2014) [67]. Goat milk supplies appropriate amounts of Vitamin A and niacin, and excesses of thiamin, riboflavin and pantothenate for a human infant. If a human infant fed only on goat milk, the infant is oversupplied with protein, Ca, P, and Vitamin A, thiamin, riboflavin, niacin and pantothenate in relation to the FAO-WHO requirements. Compared to cow milk, goat milk has significant deficiencies in folic acid and Vitamin B12 which cause goat milk anemia (Jenness *et al.,* 1980) [31]. Levels of folate and Vitamin B12 in cow milk are five times higher than those of goat milk, and folate is essential for the synthesis of hemoglobin.

2.3.12 Minerals and trace elements

Calcium and phosphate supplied by goat milk is one of the most important contributions of goat milk to human nutrition. Goat milk contains about 1.2 g calcium and 1 g phosphate per litre; these concentrations are similar to those in cow milk (Jenness *et al.,* 1980) [31]. Goat milk provides a great excess of Ca and P in relation to energy to human infant, both calcium and phosphorus of goat milk are absorbed by the human infant (Jenness *et al.,* 1980) [31].

One cup of goat milk supply 35% of our daily need of calcium and 20% of daily need of B2. High level of potassium causes goat milk to react in an alkaline way within the body however cow milk reacts in acidic way due to less amount of potassium. In Naturopathic medicine, goats are referred as bio-organic sodium animals whereas cows are referred as bio-organic calcium animals. Bioorganic sodium is an important element to keeping the joints mobile and tender (Kumar A *et al.,* 2016) [35]. Goat milk is reported to have higher content of Potassium, Calcium, chloride, Phosphorus, Selenium, Zinc and Copper than cow milk (Krstanovic *et al*., 2010) [34]. Potassium is important for the acid/base balance and also for the function of muscles, nerves and kidneys. Chloride can maintain fluid balance, blood H and osmotic pressure. Calcium (Ca) is important for building up the bone structure, but can also affects function of muscles, nerves and blood coagulation. Selenium (Se) is involved in the cell protection against free radicals, and protects body against heavy metals (Zenebe *et al*., 2014) [67]. Zinc (Zn) is a key component in several enzymes that are involved in transport of carbon dioxide, protein production and it also collaborate with the hormone insulin which regulates metabolism of carbohydrates. Copper (Cu) affects the metabolism of iron and oxygen and also the cell defense against free radicals. Iodine is an essential component in two thyroid enzymes that regulate metabolism and stimulate growth and development of the body (Aliaga-Lopez *et al*., 2005) [39].

2.3.13 Goat Milk Product

The consumer interest in the great variety of goat milk products, especially those of "organic" origin or of traditional labels has seen considerable growth recently. Goat milk apart from other milks is a significant food and nutrient source for people in many countries. Goat milk has played a very important role in health and nutrition of young and elderly. The nutritional, health and therapeutic benefits notify the potentials and values of goat milk and its specialty products. The chemical characteristics of goat milk can be used to manufacture a immense range of products, including fluid beverage products (low fat, fortified, or flavored) and UHT (ultra high temperature) milk, fermented products such as cheese, buttermilk or yogurt, frozen products such as ice cream or frozen yogurt, butter, condensed/dried products, sweets and candies. Additionally, other specialty products such as hair, skin care and cosmetic products made from goat milk recently have gained a further attention. There is increased interest in foods with a positive effect on health beyond their nutritional value, and appreciable attention has focused on probiotic products (Montoro *et al.,* 2018) [41]. The use of milk with particular nutritional properties alone or in combination with bacterial strains having probiotic properties and/or producing physiologically active metabolites, represents one of the technology options for manufacturing new dairy functional beverages (Yangilar *et al.,* 2013) [65]. Fermented milks, especially when probiotics are present, have been attributed with many properties, including: an improvement in lactose absorption, increases in protein and fat digestibility and in antibacterial activity, immune system stimulation, preventive action against digestive system cancer, anticholesterolemic action, and the enhancement of mineral bioavailability, among others. Fermented milk is broadly used to carry probiotic strains because the bacteria are kept alive, and its daily intake is recommended (Montoro *et al.,* 2018) [41].

2.3.14 Butter

Butter possesses minimum 80% of fat. In India, over 6% of the total milk is converted into butter. Goat milk lacks agglutinin, which reduces its ability to form easy clusters during butter making. Since goat milk fat has a lower melting point compared to cow milk fat it results in very soft butter at room temperatures which is not desirable. Rodriguez *et al*., 2003 optimized processing parameters for manufacture of cultured goat cream butter. Goat milk cream was inoculated with freezedried mesophilic aromatic lactic cultures and showed an increase in acidity and a decrease in lactose content, when the concentration of lactic cultures was increased. The optimal values of the fermentation process were an inoculum dosage of 8.8 U/100 l and a fermentation time of 7 h at 28 °C. This cultured formulation achieved optimal sensory quality in appearance, flavour, texture, and overall quality. At refrigerator temperature (4 °C) the cultured formulation behaved as a solid and lacked spreadability, whereas it had ideal spreadability at 15 °C when the solid fat content (SFC) was around 18%. At room temperatures of 18–25 °C the SFC was between 11 and 8%, respectively (Pal *et al.,* 2017) [44].

2.3.15 Cheese

Cheeses hold the considerable economic value among all manufactured goat milk products (Young *et al.,* 2010) [66]. Cheese is a fermented dairy product, which has hundreds of varieties. Probably, it is the most popular and well known value added dairy product. The consumption of cheese prepared from raw milk has been implicated as the cause of outbreak of brucellosis, listeriosis, and staphylococcal food poisoning (Yangilar *et al.,* 2013) [65]. Therefore, it is essential to use only pasteurized milk to manufacture cheese to protect the health of the consumer. Mehaia *et al.,* 2002 manufactured fresh soft white cheese (Domiati-type) made from goats' milk using ultrafiltration and conventional processes. The cheeses made by UF process had higher in pH, moisture content and ash, whereas protein and fat contents were lower compared to cheeses made using conventional process. An increase of 21% in cheese yield, 21–26% in protein recovery,
15–19% in fat recovery and 17–22% in total solids recovery was achieved by the UF process. Moreover, the UF process showed 83–85, 83.3, 75, 82.5 and 75% reduction in the total process time, salt, starter culture, rennet and calcium chloride

used, respectively. The mean score for texture of cheeses made by UF was significantly higher than that of cheeses made by the traditional process (Pal *et al.,* 2017) [44].

2.3.16 Milk powder

By removing the water from liquid milk, milk powder is prepared. It has better keeping quality, requires less storage space and involves low transport cost. Reddy *et al.,* 2014 optimized the processing conditions for manufacture of spray dried Osmanabadi goat milk powder. The milk solid loads of 35, 40 and 45% and inlet air temperature of 160, 170 and 180 °C were chosen as independent variables to produce the spray dried Osmanabadi goat milk powder. A mixed fruit flavour was added to the concentrated milk to avoid the goaty flavour in the final powder. The mean values of proximate composition of spray dried Osmanabadi goat milk powder *viz*., moisture content, fat, protein, carbohydrates, ash and titrarable acidity were 4.08%, 26.85%, 25.48%, 36.99%, 6.60% and 0.14%, respectively (Pal *et al.,* 2017) [44].

2.3.17 Formulated Beverage

A novel goat milk bar was developed by incorporating rose flower extracts as an added ingredient (concentration level: 0, 5, 10, 15 and 20%), and by using two different types of natural sweeteners (cane sugar and palm sugar). The nutrition bars were evaluated for proximate composition, texture properties and sensory qualities. Results obtained were encouraging and the new goat milk based nutritional bar formulation with added rose extracts certainly paves way for future commercial exploitation of the product. Goat milk, owing to its rich nutraceutical value, and rose extracts owing to the dual functions of a natural antioxidant and antimicrobial agent, can be beneficial for extending the shelf life of this novel product under room or refrigerated temperatures, thus attracting better markets (Bhat *et al.,* 2016) [11].

2.3.18 Yoghurt

Currently, yoghurt is growing in popularity allover the world, as people are now become aware of health benefits of probiotics in yoghurt. Yoghurt is a fermented milk product that can be prepared with milk, cream, and skim milk (Pal *et al.,* 2017) [44]. Usually yoghurt is made from cow milk, but milk from other ruminants such as goat, sheep, camel, were also can be used. Fermentation of milk by *Streptococcus thermophilus* and *Lactobacillus bulgaricus* will yield yoghurt with good flavor and a refreshing acid taste, semi-solid in texture, compact, contain high enough acid and no alcohol. (Costa *et al*., 2014) [19] stated that yoghurt from goat milk is an excellent source of fatty acids, mineral, protein however consumer acceptance was low due to its "goaty" flavour. Moreover, they stated that goat milk fat contain higher caproic, caprilic and capric fatty acids compared to other ruminant species (Suriashi *et al.,* 2014).

One disadvantage with goat milk is the almost nonexistent content of folic acid. In a fermented product this problem could be solved by using folate-producing bacteria during fermentation. Sanna and co-workers (2005) used a mix of *Streptococcus thermophilus* and *Lactobacillus delbrueckii* subsp. *Bulgaricus* when fermenting goat milk which resulted in to a yogurt with a significant quantity of folate and good sensory attributes.

2.3.19 Kefir

Kefir is a putatively health-promoting dairy beverage that is produced when a kefir grain, consisting of a consortium of microorganisms, is added to milk to initiate a natural fermentation. Kefir is fermented milk only made from kefir grains and kefir cultures as no other milk culture forms. Kefir grains are the mixture of beneficial bacteria and yeast with a polysaccharide matrix. During fermentation lactic acid, CO, ethyl alcohol and aromatic compounds that make its unique organoleptic 2 properties are occurred. Kefir is used for the treatment or control of several diseases for many years in Russia. It is begun to consume in some areas of the world, southwestern Asia, eastern and northern Europe, North America and Japan for its nutritional and therapeutic aspects (Otes *et al.,* 2003) [43].

2.3.20 Diary based beverages

Within dairy beverages, fresh milk, fermented milk, and yogurt drinks are the most common products, as they are considered excellent vehicles for probiotics. There are many commercial dairy beverages enriched with bioactive components, given in Table 2. Recently, clinical studies have shown that ω-3 acids may be useful in the prevention and treatment of epilepsy.

Al. Hindi *et al*., 2020 [4] produced Fermented milk beverages supplemented with pomegranate peel extract and inoculated with *Lactobacillus plantarum* and *Bifdobacterium longum* subsp *longum.*

The antioxidant activity of fermented milk beverages supplemented with pomegranate peel 150 mg/L (FMPO 150) and 300 mg/L (FMPO 300) was determined by 2,2-diphenyl-1-picrylhydrazyl (DPPH) and 2,2_-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid) (ABTS). Antioxidant activity of the fermented milk beverage FMPO 300 was higher than that of FMPO 150. The combination of pomegranate peel extract and probiotic lactic acid bacteria in a fermented milk beverage provides not only probiotic bene.ts but also bioactive phenolic compounds that could be functional and possess therapeutic effects.

Gomes *et al*., 2013 prepare three dairy beverages with different concentrations of cow's and goat's milk and whey with added guava jelly and then evaluated for their physicochemical (total solids, protein, fat, lactose, acidity, pH and syneresis), rheological (viscosity) and sensory characteristics (Quantitative Descriptive Analysis). The dairy beverage made with the milk and whey from cows and goats (Mixed Dairy Beverage e MDB) showed lactose and pH values lower than the beverage made with goat milk and whey (Goat Dairy Beverage - GDB), but higher than those of the beverage made with cow milk and whey (Cow Dairy Beverage e CDB). All the beverages received similar scores for most of the evaluated sensory attributes, with similar scores for MDB and CDB in terms of purchase intention. The development of dairy beverages with both goat's and cow's milk with added guava jelly is an interesting opportunity to produce a nutritional product that is considered satisfactory by consumers.

Silveira *et al*., 2014 [56] prepare chocolate goat dairy beverages with the probiotic *Bifidobacterium lactis* and evaluate the effects of goat cheese whey and prebiotics (inulin and oligofructose) on the physicochemical parameters and sensory features of the beverages. All of the formulations (n ¼ 7) exhibited decreased pH values and a concomitant increase in acidity during refrigerated storage. Beverages made with the lowest amounts of whey (F1 and F3) exhibited a greater decrease in pH after 14 days of storage. B. lactis exhibited counts between 6 and 8 log CFU per mL. F4

presented the highest median sensory attributes for flavor and aroma, which may be related to the larger amounts of prebiotics and whey in this formulation. Thus, F4 is considered to be the formulation that best represents the desirability profile chosen for the probiotic chocolate goat dairy beverage as defined as probiotic viability above 7 log CFU per mL and improved viscosity and sensory features.

Sharma R *et al*., 2020 [55] prepare flavoured milk with different combinations of milk and carrot juice *viz*.100:0 (T1), 98:2 (T2), 96:4 (T3), 94:6 (T4) and 92:8 (T5) with five treatments and four replications in completely randomized design (CRD). Flavoured milk prepared by blending with 6 parts of carrot juice (T4) had secured the highest score (90.55). Similarly chemical properties *viz*., Acidity, ash significantly increased by treatment (94% double toned milk + 6% carrot juice) when compared with control and other remaining treatments but fat, protein,total solids, SNF significantly decreased by the addition of increasing concentration (0-8%) of carrot juice. Thus, it is inferred that good quality flavoured milk with utilizing carrot juice can be prepared by 94 parts of double toned milk +6 parts of carrot juice, 8 per cent sugar and 0.1 per cent cardamom.

2.3.21 Marketing Potential of Goat milk and its products

Goat milk was approved as an effective dietary item for the patients suffering from tuberculosis, dysentery, cough and cold and certain gynaecological disorders (Pal *et al.,* 2011) [45]. Recently, there has been a renewed interest in goat milk as an alternative milk source for people with cow milk intolerance. Demand for organic and healthy dairy food has been increasing wolrdwidely including India. Interest of consumer in toxic residue-free milk will further benefit India, the highest goat milk producer in the world, where natural pasture grazing of goats predominates. In past few years, there has been an increased interest for goat milk production and conversion to value added products (Bhattarai *et al.,* 2012) [12].

The most important quality standard for goat milk is acceptable, attractive milk odor and taste. Park stated that the two biggest barriers in marketing goat milk are negative public perception of "goat like" flavor and seasonal milk production, which prevents year-round uniform marketing (Young *et al.,* 2010) [66]. The origin of this misconception is due to the fact that goat milk is sometimes obtained in poor sanitary conditions and that goat milk products are poorly manufactured. Widespread teaching of goat milk benefits and good taste can only transpose this poor reputation (Yangilar *et al.,* 2013) [65]. Technological approaches are needed to sort out the seasonal milk supply, such as ultrafiltration of milk, freezing and storage of curds, spray-drying, and production of mixed-milk cheeses. Major factors for successful marketing of dairy goat products include consumer reception of safety and nutrition, quality of flavor, body texture, and appearance, availability of specialty types, attractiveness of packaging, relative price of products and establishment of proper distribution and marketing channels. The marketing value of dairy products in developed countries is estimated around US $14180 million. In few countries, the growth is expected to cross more than 30% (Bhattarai *et al.,* 2012) [12]. Inspite of much larger volume available of cow milk, it is much cheaper production usually and therefore, lower market price, the production and marketing of goat milk and its products is therefore, an essential niche in the total dairy industry sector (Kumar *et al.,* 2017) [36]. But according to Yangilar *et al.,* 2013 [65] as more and more advantages of goat milk over bovine milk have been discovered, such as easy digestion, special flavor, higher concentration of some nutrients, the demand of goat milk has been fast increasing worldwide and goat milk comands higher price than cow milk.

Table 2: Functional dairy beverages with added bioactive component (Sharma R. *et al*., 2005) [54].

Functional dairy beverage	Brand name	Manufacturer	Source of bioactive	Comments
Low-fat milk	Lactantia nature addition	Lactantia (Parmalat), Canada	Omega-3 (flaxseed oil)	300 mg/250 mL serve, mainly ALA
Low-fat milk	Herat Plus	PB Food Australia	Omega-3 (fish-oil)	200 mg/250 mL serve, mostly DHA and EPA
Low-fat milk	Natrel Omega-3	Natrel Canda	Omega-3 (Organic flaxseed oil)	300 mg/250 mL serve
Low-fat milk (Fresh)	Dawn Omega milk	Dawn Dairy, Ireland	Omega -3 (fish oil)	150 mg/250 mL serving. Europe's first, fresh pasteurised
Low-fat milk	Farmers Best	Dairy Farmers, Australia	Omega-3 (vegetable oil)	33 mg/250 mL serve. First product to be made from fresh milk where almost all saturated fat has been replaced with the healthier monounsaturated and Omega-3 fats. Approved by the National Heart Foundation of Australia
Low-fat milk (UHT) and milk powder	Omega plus	Nestle, Malaysia and Singapore	Omega-3 (vegetable oil-canola and corn oil)	UHT and powdered milk

Table 3: Milk- based beverages containing probiotic microorganisms (Turkmen *et al*. 2019)

Single or Multiple strains of probiotics	Product	Manufacturer	Claim
Lb. acidophilus	Namyang Jayeonui flavored probiotic yogurt drink	Namyang Dairy Product	Stimulate digestive system
Lb. casei (or *Lb. paracase*i)	Actimel (strain Danone® also known Lb. casei CNCM I- 1518 or Lb. casei DN 114 001)	Danone	Support normal function of immune system
B. bifidum or *B. longum*	Caldus Milk (Bifidus milk) (B. bifidum strain BB536)	Morinaga Milk	Holds for specifie health use (FOSHU) status
Bifidobacterium spp.	Mengniu/Mönmilk Guan Yi Ru Original Bb-12 (strain Bb-12)	Mengniu Dairy	Improve digestive system and stimulate immune system
Lb. acidophilus+Bifidobacteriu m spp.	Dreaming probiotic yogurt drink (B. animalis strain Bb-12)	Dreaming Cow	Improve digestive system and stimulate immune system

2.4 Medicinal values of goat milk

Other than nutritional advantages, demand for goat milk derives from a medical purpose, on the affliction of people with cow milk allergies and other gastrointestinal ailments (Ribeiro *et al.*, 2010) [49]. Due to its high medicinal value for human health, the value of goat milk has increased globally. Descriptions in an ancient Chinese medical text of goat milk as a tonic for the digestive system in 1578 can be supported by growth factor activity in goat milk, as related by (Wu *et al*., 2006), who called goat milk a feasible nutraceutical for gastrointestinal disorders. It is easier to digest than cows' milk and may have certain therapeutic value (Haenlein *et al*., 2004) [28]. According to (Park and Haenlein *et al*., 2007) [47] goat milk differs from cow or human milk in its higher digestibility, distinct alkalinity, higher buffering capacity, and therapeutic values in medicine and human nutrition. Many hospitals and medical practitioners kept a list of sources of goat milk that they could recommend to patients (Ulusoy *et al.*, 2015) [63].

When goat milk is fed to the infants, the symptoms like gastrointestinal disturbances, vomiting, colic, diarrhoea, constipation and respiratory problems can be eliminated. Pasteurized goat milk is well tolerated by the infants having gastro intestinal or respiratory symptoms. Regular intake of goat milk remarkably improves the body weight gain, improved mineralization of skeleton, increased blood serum vitamin, mineral and haemoglobin levels (Morgan *et al*., 2012) [42]. Goat milk is a good source of potassium, a vital mineral for maintaining normal blood pressure and heart function and protect against atherosclerosis (Getaneh *et al*., 2016) [26].

The higher proportion of medium-chain fatty acids in goat milk are known to be anti-bacterial, be antiviral, inhibit development and dissolve cholesterol deposits, and be absorbed rapidly from the intestine. According to some authors, goat's milk can be consumed without negative effects for people suffering cow milk allergy. This is one of the reasons highlights the market potential of goat milk. However, symptoms of allergy to goat milk appeared at a much later age than cow- milk allergy which may benefit younger infants who are dependent on milk as their main source of nutrients. In addition, allergy-related symptoms to goat milk may develop in individuals who have already developed an allergy to cow milk (Ulusoy *et al*., 2015) [63]. Bevilacqua *et al*., 2001 suggested that the reduced allergenicity of goat milk might be directly related to the lower levels of αs1- casein.

Goat milk is also effective against cardiovascular disease (CVD) involve heart and blood vessels; coronary heart disease, high blood pressure, arrhythmias and atherosclerosis. Goat milk is rich in medium-chain triglycerides (MCT) including fatty acid esters of caproic, caprylic and capric fatty acids act anti-anthrogenic. Goat milk has played an important role in almost all biological reactions and exerts antioxidant and anti-inflammatory effects in the body. This is important as inflammation is the body's primary response to infection and oxidation has been linked to the development of many diseases, including cancer. Goat milk has a high content of conjugated linoleic acid (CLA), anti-carcinogenic properties of CLA have been reported against mammary and colon cancer in animal models, as well as *in vitro* models of human melanoma colorectal and breast cancer. Goats' milk is a good source of potassium, an essential mineral for maintaining normal blood pressure and heart function. Since a cup of goat's milk contains 98.7 mg of K and 121.5 mg of sodium, hence it helps to prevent high blood pressure and protect against atherosclerosis (Getaneh *et al.*, 2016) [26].

3. Future Prospects

The role of traditional beverages in the future of the fermented beverage industry may be to inspire the development of new products (and assess a country's willingness to accept a product), whereby it is easier to develop simple, novel beverages and directly evaluate the functional and sensory properties in controlled fermentations with minimum variables. Fermented milks, especially yoghurt-style products, are the most popular functional beverages. Dairy-based produce account for approximately 43% of the functional beverage market, and is mainly comprised of fermented products. Additionally, a research into the fermentation of waste and by- products products (e.g. whey) continues, there is the potential for a significant environmental impact. As developed society becomes more health-conscious, particularly in response to the growing obesity epidemic, the market for functional food appears to be in a long-term, sustainable trend, with beverages constituting a substantial share of this market. Aside from marketing to health-conscious (and high-income) consumers, there is evidence that functional beverages could function as a therapeutic product, particularly as a means of delivering nutrition to, and improving the health of, malnourished populations. This medicinal impact may also be augmented by the growing field of nutraceuticals, addition of cholesterol-controlling factors, and in terms of probiotics, the alleviation of intestinal discomfort and aiding in the recovery from antimicrobial treatment.

It is also intriguing to note that a number of food companies that have been under pressure, due to the poor public perception regarding the 'healthiness' of the foods they produce, are now focusing on developing such functional products. Expanding technological capabilities, especially ingredient exploration and development, has led to increased functional product innovation. The number of new products with functional claims has been growing by approximately 28% per year. Consumers' willingness to pay a premium price for fortified products is also a key driver for innovation. While most current functional beverages are aimed at the high-income consumer, there is an argument to be made that those who would benefit most from fermented beverages are from underdeveloped nations, where such beverages could provide a cost-effective means of delivering much-needed nutrition.

4. Conclusion

Nowadays dairy industries are looking for new product ideas and technologies to meet the ever increasing consumer requirement for healthy foods and to increase the profitability. Recently it is watched that there has been increasing demand to foods that has functional foods. Functional foods can be defined as foods that have positive effects on the health. Functional dairy beverages can satisfy the growing market need for health, taste and convenience, but the formulators require significant knowledge of the bioactive components and their interaction with dairy components. An important development in this regard has been in goats'milk mixed products. Studies showed that being one of the earliest domesticated animals in the world, goats will always be an important part of human culture. Their compact size (compared with cows) makes them appealing from a herd

management and milking standpoint. Additionally, physiological differences render unique physical characteristics to goat milk in terms of flavor profile, fat globule size, coagulation properties, and allergenicity, making goat milk the dairy product of choice for many consumers. Goat milk products are considered to be the dairy products with greatest marketing potential. Fermented goat milk incorporating live probiotic cells represent a group of products with great prospects in the future with regard to their nutritive and therapeutic properties. Various goat products including fluid, fermented, frozen, condensed, and dehydrated milk products are produced in many countries. Goat and its products are recognized as an important source of protein, calcium and phosphorus, especially in under developing nations of the world. Moreover, it also has medicinal value for human being as it is effective against cardiovascular disease, control blood pressure and is healthy alternative to cow's milk that may be more easily digested than regular cow's milk, especially to children and those who have sensitive stomachs to other animals' milk.

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